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South Dakota Feed Grains Used for Swine Feeds

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SOUTH DAKOTA FEED GRAINS USED FOR SWINE FEEDS

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Common South Dakota grains are corn, opaque-2 corn, wheat, grain sorghum, millet (Proso-white), barley, oats, rye and Triticale (durum wheat and rye). The chemical analyses of these cereal grains and soybeans are listed in table 1.

The value of a feedstuff is based on several factors; acceptability (how well the material will be consumed by an animal), energy availability and as a source of other nutrients (proteins, vitamins and minerals). Should a swine producer feed corn or wheat or barley or oats and others as a grain ingredient? In South Dakota, this will depend primarily upon availability, cost of these ingredients and their value as a source of energy for swine.

Corn

Corn contains less protein but more energy than other cereal grains. Because of its abundance and readily available energy, corn is used as the base cereal for comparing the nutritive value of other cereal grains. Corn is low in protein and its protein is deficient in the amino acids lysine, methionine and tryptophan. A ration balanced for protein using corn and soybean meal may be slightly deficient in these three amino acids for swine.

Opaque-2 Corn

Opaque-2 corn differs from normal corn in that it contains a mutant gene that provides the corn with a higher level of lysine and tryptophan. Experiments at South Dakota State University with growing-finishing swine have shown that 1 1/2 to 3% lower protein diets can be fed when using opaque-2 corn because of its superior amino acid balance.

Tables 2 and 3 show the diet composition and results of experiments when feeding high-lysine corns as reported at the 1973 South Dakota Swine Field Day (A.S. Series 73-42). Sixty pigs were fed diets of normal, opaque-2 or double mutant corn supplemented with minerals and vitamins but without supplemental protein from 132 to 200 pounds. Gains were increased from 1.32 to 1.50 lb. per day by feeding the higher lysine corns (opaque-2 and double mutant). However, these corns do not contain adequate lysine to support optimum gains as pigs fed a corn-soy diet gained at the fastest and most efficient rate. Feed/gain was only slightly reduced when opaque-2 corn was fed.

Table 1. Proximate Analyses of Cereal Grains and Soybeans

	Crude protein	Lysine	Crude fat	Crude fiber	ME	Swine TDN	Calcium	Phosphorus
	%	%	%	%	Cal/kg[a]	%	%	%
Corn	9.0	.22	4.0	2.0	3168 (1427)	80	.01	.25
Opaque-2 corn	9.0	.40	4.0	2.0	3168 (1427)	80	.01	.25
Wheat	13.5	.40	1.9	3.0	3220 (1450)	79	.05	.41
Grain sorghum	11.0	.27	2.8	2.0	3229 (1454)	78	.04	.29
Proso millet	11.5	.21	3.6	6.5	2881 (1297)	70	.05	.30
Barley	11.5	.40	2.0	6.0	2870 (1292)	70	.06	.40
Oats	12.0	.34	4.0	11.0	2710 (1220)	65	.09	.33
High-protein oats	16.0	.60	4.0	11.0	2700 (1220)	64	.09	.33
Rye	12.5	.40	1.8	2.8	2712 (1221)	75	.08	.30
Triticale	18.0[b]	.58	1.5	2.5	3190 (1455)	77	.05	.35
Soybeans, cooked	38.0	2.40	18.0	5.0	3540 (1594)	92	.25	.59
Soybean meal	44.0	2.85	1.0	7.0	2825 (1272)	71	.25	.60

[a] ME, Cal/lb. in parentheses.
[b] 10% moisture.

Table 2. Composition of Diets (Percent)

	Treatments			
	1	2	3	4
Normal corn, ground	97.4	--	--	89.8
Opaque-2 corn, ground	--	97.4	--	--
Double mutant corn, ground	--	--	97.4	--
Soybean meal (44%)	--	--	--	7.9
Dicalcium phosphate	1.4	1.4	1.4	1.1
Ground limestone	.5	.5	.5	.5
Trace mineral salt (.8% zinc)	.5	.5	.5	.5
Vitamin-antibiotic premix[a]	.2	.2	.2	.2

[a] Provided per lb. of diet: 1500 IU vitamin A, 350 IU vitamin D, 1.25 mg riboflavin, 5 mg pantothenic acid, 10 mg niacin, 50 mg choline, 7.5 mcg vitamin B_{12} and 5 mg oxytetracycline.

Table 3. Results of Feeding Opaque-2 and Double Mutant Corn to Finishing Pigs

	Corn			
	Normal	Opaque-2	Double mutant	Corn-soy
Number of pigs[a]	15	15	15	15
Avg. initial wt., lb.	132.2	132.3	132.3	132.3
Avg. final wt., lb.	198.9	201.3	201.6	202.5
Avg. daily gain, lb.	1.32	1.50	1.50	1.59
Avg. daily feed, lb.	6.41	6.36	6.58	6.64
Feed/gain	4.84	4.24	4.40	4.16

[a] Three lots of five pigs each per treatment.

Wheat

Wheat is about equal to corn in energy value, palatability and digestibility. Its protein varies more but is considerably higher than that in corn. When compared with corn, wheat contains about one-third more protein. Its protein is deficient in lysine and tryptophan and limited in methionine. Wheat, unlike corn, contains no vitamin A activity. Recommendations are that you use the same amount of protein supplement when formulating rations with wheat as with corn.

A 16% protein corn ration would contain 80% corn and 20% soybean meal. This ration would contain the desired .75% lysine. A 16% protein ration using wheat would contain 90% wheat and 10% soybean meal. This ration would contain only .60% lysine, which is considered low for a 16% protein grower diet. Formulating a .75% lysine ration with soybean meal and wheat to equal that of corn and soybean meal would require 84% wheat and 16% soybean meal. This ration would contain 18% crude protein. This means that only 320 lb. of soybean meal are needed to balance the lysine level in a wheat-soybean meal ration compared to using 400 lb. of soybean meal in a corn-soybean meal ration, a difference of 80 lb. of protein concentrate. Therefore, the balancing of a wheat ration on a percent lysine basis instead of crude protein is even more satisfactory than the general recommendation that you use the same amount of protein supplement with wheat as with corn.

Wheat should be cracked or ground. When ground too fine, it has a tendency to form a pastry mass in the mouth and reduces feed intake. Rolling, if possible, is the best method for grinding wheat.

It is very important that wheat rations be properly supplemented with recommended levels of vitamins and minerals. Suggested rations containing wheat are shown in table 4.

Table 4. Swine Rations Containing Wheat

Ingredient	Grower	Finisher
Wheat, ground	1534	1764
Soybean meal (44%)	410	184
Dicalcium phosphate	20	18
Calcium carbonate	16	14
Salt, trace mineral (1% zinc)	10	10
Premix[a]	10	10
Calculated protein, %	19.4	16.0
Calculated lysine, %	.90	.61

[a] As suggested in Pork Industry Handbook Fact Sheet 2, Vitamins for Swine.

Grain Sorghum

Grain sorghum (sometimes referred to as milo) has been used extensively in swine rations in the southwest. In addition to being free from dangers of blight, grain sorghum is more drought resistant than corn. Sorghum can replace up to 100% of the corn in a swine diet on a pound for pound basis, ignoring its protein content. The chemical analysis of grain sorghum as shown in table 5 indicates a very similar nutrient composition to corn. Grain sorghum differs, however, in the following ways:

1. More variability in crude protein content but, on the average, slightly more protein. Even though grain sorghum frequently contains more protein than corn, the two are very similar in lysine content. Therefore, approximately the same amount of supplemental protein should be used with either grain sorghum or corn.

2. No vitamin A activity.

3. Approximately 5% less energy.

Table 5. Nutrient Composition of Grain Sorghum and Corn[a]

Nutrients	Grain sorghum	Corn
	%	%
Dry matter	89.0	89.0
Ash	1.7	1.3
Crude fiber	2.4	2.2
Fat	2.6	3.8
Nitrogen-free extract	72.3	72.7
Crude protein	11.0	9.0
Calcium	.03	.02
Phosphorus	.28	.25
Amino acids		
Cystine	.20	.13
Lysine	.20	.25
Methionine	.10	.17
Threonine	.27	.36
Tryptophan	.09	.09

[a] Considerable variation in nutrient composition exists between samples. The figures here are averages from a number of sources.

Grain sorghum has a tendency to have a hard outer coat. Therefore, it should be ground, cracked or rolled before feeding. Rations containing grain sorghum are shown in table 6.

Table 6. Suggested Swine Rations Containing Grain Sorghum

Ingredient	Pigs from 30 to 50 pounds	Pigs from 125 lb. to market
Grain sorghum	1488	1745
Soybean meal (44%)	450	200
Limestone (38% Ca)	15	8
Dicalcium phosphate (26% Ca, 18% P)	25	25
Iodized salt	10	10
Trace mineral premix	2	2
Vitamin premix[a]	10	10
Calculated protein, %	18.45	14.00
Calculated lysine, %	.79	.47

[a] As suggested in Pork Industry Handbook Fact Sheet 2.

Barley

Compared with corn, barley contains about one-third more protein, two times more fiber and is deficient in the amino acid lysine. Therefore, it is lower in energy than corn. Barley can replace 100% of the corn in the diet. Diets should be balanced to provide adequate lysine and ignore the additional protein content of barley. Because of the higher fiber content of barley, diets which contain this grain will produce slightly lower gains. When properly supplemented with protein, vitamins and minerals, ground barley is worth about 90 to 95% as much as shelled corn for hogs. Suggested rations are shown in table 7.

Barley is not well adapted to self-feeding free choice because pigs usually eat more of the protein supplement than is required to balance the ration. This is because barley is less palatable. For this reason, it is best to feed the barley and supplement together as a mixed ration.

Barley that is infested with scab may be fed to growing-finishing pigs, providing it is limited to 10% of the ration. In no case should the scab-infested barley be fed to the gestating-lactating sows or young pigs.

Table 7. Suggested Swine Rations Containing Barley

Ingredient	Grower	Finisher
Barley	1640	1810
Soybean meal (44%)	300	140
Dicalcium phosphate	30	22
Ground limestone	10	8
Trace mineralized salt	10	10
Vitamin premix[a]	10	10
Calculated protein, %	16.26	13.48
Calculated lysine, %	.74	.56

[a] As suggested in Pork Industry Handbook Fact Sheet 2.

Oats

The protein content of oats is approximately one-third higher than in corn and oats is deficient in lysine. Oats contains four times more fiber than corn. Oats are considered a good feed for growing pigs and brood sows but are too high in fiber and too bulky to constitute a major portion of the ration for young pigs. For growing-finishing pigs, good quality oats weighing 32 lb. per bushel or more are worth as much as shelled corn, pound for pound, when limited to less than one-third of the ration. For mature breeding animals, the oat content may be higher. Tests at South Dakota State University using ground whole oats in sow gestation diets have shown very desirable results if the lower energy of oats is taken into consideration and about one-third more feed is provided daily to the sow. Oats contain no vitamin A activity and must be ground for best utilization. Suggested rations of oats and corn are shown in table 8.

Table 8. Suggested Oats Rations With Corn

Ingredient	Pigs from 30 to 50 pounds	Pigs from 50 to 125 pounds	Pigs from 125 lb. to market
Ground corn	958	1058	1290
Ground oats	500	500	500
Soybean meal (44%)	480	380	150
Calcium carbonate (38% Ca)	12	12	8
Dicalcium phosphate (26% Ca, 18% P)	28	28	30
Iodized salt	10	10	10
Trace mineral premix	2	2	2
Vitamin premix[a]	10	10	10
Calculated lysine, %	.90	.76	.52

[a] As suggested in Pork Industry Handbook Fact Sheet 2.

Hulled oats are valuable in rations for very young pigs, 100 lb. being equal to 140 lb. of corn. However, it takes 155 to 165 lb. of whole oats to produce 100 lb. of hulled oats. Oats contain about 30% hulls.

High-Protein Oats

Recent work by plant breeders has resulted in several varieties of oats that are considerably higher in protein than varieties of the past. High-protein oats contain 30 to 40% more protein and the important amino acid lysine. The feeding of high-protein oats to growing-finishing pigs at the South Dakota station provides the following conclusions:

1. Considerable supplemental protein can be saved as a result of use of high-protein, high-lysine oats.

2. Tests have shown that high-protein oats can replace up to 50% of the grain in swine diets without detrimental effects.

Rations based on high-protein oats are shown in table 9.

Table 9. Suggested High-Protein Oats Rations

Ingredient	Pig starter		Growing-finishing	
Corn	768	736	912	890
Spear oats	800	800	800	800
Soybean meal (48%)	372	--	228	--
Soybean meal (44%)	--	404	--	250
Dicalcium	26	26	26	26
Limestone	16	16	16	16
Trace mineralized salt (1% zinc)	8	8	8	8
Vitamin premix[a]	10	10	10	10
Calculated lysine, %	.90		.70	

[a] As suggested in Pork Industry Handbook Fact Sheet 2.

Rye

Swine producers use less rye than other small grains in formulating rations. Rye is similar to wheat in chemical composition but is less palatable to pigs. It is normally fed in combination with more relished feeds and limited to no more than one-half of the swine ration. When properly supplemented, ground rye has a feeding value 90% that of corn. It should be ground for hog feed. Table 10 lists rations containing rye that can be fed to growing pigs.

Table 10. Suggested Swine Rations Containing Rye

Ingredient	Growing pigs 1	2
Corn	1240	920
Rye (11.8%)	300	600
Soybean meal (44%)	400	420
Dicalcium phosphorus	20	20
Ground limestone	20	20
Iodized salt	10	10
Vitamin premix[a]	10	10
Calculated protein, %	16.17	16.94
Calculated lysine, %	.77	.84

[a] As suggested in Pork Industry Handbook Fact Sheet 2.

Rye is one of the grains which may contain a fungus, ergot. The general recommendation, because of the possible presence of this fungus, is for growing and finishing diets to contain no more than 20% rye. Reduced gains can be expected if ergot is present and most tests show a 10% decrease in feed conversion compared with corn diets. Rye is not recommended in sow gestation diets because of the possibilities of ergot interfering with pregnancy, causing abortion. Likewise, ergot should not be permitted in the ration of lactating sows or sucking pigs.

The University of Illinois at their 1966 Swine Growers Day reported that rye fed at levels of 15% of the diet did not materially affect performance of growing-finishing swine (average daily gain, 1.62 lb.; feed/lb. gain, 3.85 lb.). A 30% level depressed both rate of gain and feed efficiency (average daily gain, 1.49 lb.; feed/lb. gain, 4.15 lb.). Complete replacement of corn with rye markedly depressed rate of gain and feed efficiency.

Triticale

Triticale is a relatively new grain resulting from crossing durum wheat and rye. Thus, it has some of the same feeding values as its contributing parents. Triticale may contain a fungus, ergot. Triticale is not recommended for sow gestation diets because of the possibility of the presence of ergot.

Michigan State University reported that triticale can replace up to 60% of the corn in swine diets. The Nebraska North Platte Station reported that triticale can be successfully used as a replacement for corn in growing-finishing swine diets. North Dakota workers recommend that triticale be limited to a maximum of 25% of the ration for growing pigs or 50% of the grain mixture for finishing pigs. Rations containing different levels of triticale are shown in table 11.

Agronomists at South Dakota State University indicate that triticale yields are similar to wheat when compared in the standard variety trials throughout the state.